

down in flood and destroyed the banana trees planted along their banks, and carried away several bridges. Among the latter was the Barnet Bridge at Montego Bay; 3 out of the 5 mason-work arches were carried away, and the river, which rose 20 feet above its usual level, took a short cut from the railway bridge through the railway station to the sea.

Cane Valley, near the center of the island, suffered again, but not to the extent it did in June, 1886, when the water rose 60 to 100 feet. The flood rains that year were much heavier than the rains we are now considering, but they were both due to the same cause; namely, a barometric depression.

The barometer falls slightly over a very large area, much rain falls, a definite center is formed, and the whole phenomenon may, or may not, develop into a great cyclone.

The two depressions of June 13, 1904, certainly developed into cyclones, but nothing more was heard of the depression of June 7 and 8, 1886.

RECENT CONTRIBUTIONS TO CLIMATOLOGY.

By C. F. TALMAN, U. S. Weather Bureau.

Observational work in meteorology may be said to correspond to field work in the biological sciences, and has led up to corresponding conditions in recent years. The biologist of to-day finds himself confronted with an enormous mass of taxonomic material, which he has lately set himself seriously to the task of digesting and summarizing, so that it may form the basis of philosophical research. In a like manner the meteorologist has now observed the weather for longer or shorter periods over a great part of the earth's surface, but has only recently devoted much attention to the highly important work of computing means of the various series, in order to establish normal values for the climate of each meteorological station and group of stations.

The delay in reaching this stage in climatological investigation was in a measure justified by the fact that the extra-tropical regions, in which the majority of long weather records exist, are just those in which the weather variability from year to year is greatest, and in which, therefore, very long records are needed before satisfactory normals can be deduced. For example, it is estimated that the normal monthly temperature of Vienna for the winter months will not be known to within 0.1° C. of accuracy until four hundred years of recorded observations shall be available for discussion; while in western Siberia observations for eight hundred years will be needed.¹ When we come to consider the prospect of obtaining accurate decadal, pentadal, or daily normals, the extent of the record required seems to relegate the whole subject to our remote posterity. It should be remembered, however, that practical climatology does not, for all purposes, require minute exactitude in its numerical results; the determination of a monthly normal temperature to within one or two degrees of accuracy is exceedingly serviceable, while even the rough results obtained from two or three years of observations are vastly better than nothing. This fact has found recognition, and climatologists have recently been quite industrious in giving us mean values based on short records.

The immediate occasion of the present paper is the appearance, during the current year, of two very notable contributions to the quantitative climatology of extensive regions of the earth. These are:

Klimatographie von Österreich. I.—Klimatographie von Niederösterreich, von J. Hann. Wien, 1904.

Indian Meteorological Memoirs, Vol. XVII. I.—Normal monthly and annual means of temperatures, wind, humidity, cloud, rainfall, and number of rainy days of stations in India, etc. Calcutta, 1904.

The former of these works, which is published under the

direction of the Austrian Zentralanstalt, inaugurates a series of sectional climatographies, sixteen in number, which when complete will cover the whole of Austria. Coming from the pen of the most eminent of living climatologists, this memoir may be considered the embodiment of the best and most modern climatological ideas. In fact, Doctor Pernter, the Director of the Zentralanstalt, in his introduction to the series pays a tribute to his distinguished predecessor and teacher, Doctor Hann, to whom, he says the preparation of the initial monograph was entrusted, in order that the authors of the subsequent parts might have for their guidance a perfect model for form and method.

Given a series of meteorological observations which it is desired to discuss fully in the form of tabulated averages, the number of tables required in order to bring out every feature of the climate deducible from the original figures is very large. This fact is well illustrated by the work now under consideration. Taking the temperature tables alone, we have, for certain stations: Mean variability of the daily mean temperature (for each month and for the year); mean frequency of daily temperature changes of given magnitudes (comparing the mean of each day with the mean of the next); departure from normal mean temperature for the coldest and warmest winters, and for the coldest and warmest summers, during one hundred and twenty-five years; extreme monthly and annual mean temperatures for fifty years; mean monthly, seasonal, and annual temperatures at various altitudes; probability that the yearly minimum will fall below 0°, -5°, -10°, -20°, etc.; average dates on which, in the annual march, the daily temperature rises above and falls below 5°, 10°, and 15°; duration, in days, of a daily temperature of 5°, 10°, and 15°; mean difference between the 2 p. m. and 7 a. m. temperatures for each month and for the year; besides the values regularly found in climatological summaries, such as the monthly and annual means, the means of the monthly and annual extremes, and the absolute extremes.

In the discussion of the other elements, the following are some of the tables introduced: Fluctuation of the yearly totals of rainfall for twenty years (the value for each year expressed as a percentage of the 20-year mean); distribution of the annual rainfall among the months (per cent); mean duration of rainless and rainy periods for each month and for the year; mean number of days on which the wind velocity reaches 6 (decimal scale) for each season and the year; influence of the wind direction upon the several meteorological elements.

It will be seen that a number of climatic features are here brought out which are commonly neglected in climatological discussions; but, far from exhausting the possibilities in this direction, Doctor Hann's memoir only opens up new vistas to the climatologist. It is probable, however, that nearly all aspects of the climate of Lower Austria which are of practical interest and for which materials were available are here presented. There is no discussion of pressure, because, as the author says, "the differences thereof over the relatively small surface of a country like Lower Austria have no climatological importance." Phenological figures also are omitted because of the lack of trustworthy observations.

The arrangement of this work presents some very excellent features. The area under discussion is divided into a few climatic regions, which are discussed separately. The stations in a single region are considered together in connection with each climatic feature; then a compact climatic table is given for each station. Finally, at the end of the volume the more important climatic values are more fully presented in general tables, convenient for reference.

Turning now to the latest of the Indian Meteorological Memoirs, we are confronted with a work of truly imposing proportions, the plan of which presents many contrasts to that of the Austrian memoir we have just been considering. While

¹ Hann: Handbuch der Klimatologie. I Bd. Pp. 11-12.

the region discussed by Doctor Hann was but some seven or eight thousand square miles in extent, the domain of the Indian climatologist amounts to above two million square miles, including, in addition to the Indian Peninsula, stations in Ceylon, Burma, Persia, and Afghanistan, and even stations so remote as Aden, Mauritius, and Zanzibar.

This vast territory is, of course, hardly amenable to the methods of discussion employed by Doctor Hann. The number of stations represented in connection with the various elements other than rainfall ranges from 107 to 171, while the number of rainfall stations included is 2219. Only in the case of the rainfall values is there any attempt at topographic grouping. In the other tables the stations are arranged roughly in a series, beginning in Burma, stretching thence, by way of the Ganges plain and the Himalayas, to the north-west frontier; then, taking a fresh start at Colombo (Ceylon), passing up the Malabar coast, thence across the Deccan and down the Coromandel coast, and winding up at Trincomalee (Ceylon), after which come various islands and other outlying and extra-Indian stations. The climatic regions indicated on the various charts published by the Indian Meteorological Service are not distinguished typographically in these tables, and no regional means are given. This is to be regretted; but perhaps we should consider this memoir as a mere provisional compilation, since the values which it embraces were, as the compiler states, computed in order to furnish the data for a Climatological Atlas of the Indian Empire, the early publication of which has been sanctioned by the government of India. At any rate every meteorologist will welcome the appearance of so vast an array of normal values for this important region, whose climate is so frequently made the basis of investigations of the great problems of the atmosphere, and is so often called upon to furnish the weapons of controversy to the meteorological theorists. While previous publications of the Indian Service have contained normal values, introduced generally in connection with current values for purposes of comparison, these are now for the first time brought together in a compact volume devoted to the presentation of normals exclusively, and constituting a standard reference book upon Indian climate. Among the distinguishing features of this work are the reduction-constants, for various elements, given for each station, whereby true daily means may be obtained from the means of the observed readings. The methods of obtaining these constants have been discussed in previous numbers of the Indian Meteorological Memoirs. These corrections are applied in the tables, and thus we have what purport to be true diurnal means of the several elements. Other noteworthy features are a table of average monthly and annual mean temperatures reduced to sea level, and tables of the average monthly and annual "steadiness of the wind" at observation hours and for the day.

Minor contributions to climatology have of late appeared in such numbers that it is not easy to select those most worthy of mention. The present year has witnessed the beginning of an important series of publications entitled Climatological Observations at Colonial and Foreign Stations, in which the British Meteorological Council will publish summaries of the observations which it receives from the Foreign Office, the Colonial Office, and directly from observers in various British dependencies and in foreign countries. This undertaking recalls the valuable Meteorological Observations at the Foreign Stations of the Royal Engineers and the Army Medical Department, which appeared in a single volume published in 1890. It is a similar work to that undertaken by the Deutsche Seewarte, in its Ueberseeische Beobachtungen, except that the British reports are apparently not to contain daily values. In the first and only number which has come to hand—Tropical Africa, 1900–1901–1902, with Summaries for Previous Years—we have the various yearly summaries

for each station in the region indicated brought together, and a few lustral means also appear. It is to be hoped that future publications in this series will give us averages derived from the whole extent of each record; in other words, provisional normals, which the record of each subsequent year will bring nearer to the true normal values for the station.

In the enumeration of recent contributions to climatology might, of course, be included a number of well-known serial publications, appearing at fixed intervals, which regularly include normals brought up to date. These, however, the writer hopes to discuss in a subsequent paper, in connection with certain standard reference books of climatology.

The establishment of normal values, or rather of series-means which are a more or less close approximation to normal values, is now going forward apace, and the climatologist begins to hope that all of the world's vast accumulation of meteorological observations will soon have been made to bear fruit in the shape of summarized climatological data. In this connection reference may be made to the forthcoming Climatology of the United States, now in preparation in the Central Office of the Weather Bureau, which will give in a concise form the normal climatic values for upward of 600 stations in our own country. Professor Henry, who has this work in charge, hopes that it will be ready for distribution by the autumn of 1905.

RECENT PAPERS BEARING ON METEOROLOGY.

MR. H. H. KIMBALL, Librarian and Climatologist.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a —.

Science. New York. Vol. 20.

Bishop, S. E. The cold-current system of the Pacific, and source of the Pacific Coast Current. Pp. 338–341.

Smithsonian Miscellaneous Collections. Washington. Vol. 2.

Fowle, F. E., Jr. The absorption of water vapor in the infra-red solar spectrum. Pp. 1–12.

Nature. London. Vol. 70.

— Marconi weather telegrams. Pp. 396–397.

Eliot, John. The British Association at Cambridge. Section A. Subsection Cosmical Physics. Opening Address. Pp. 397–406.

Cohen, J. B. Sooty rain. P. 424.

Ashworth, J. R. A source of the ionisation of the atmosphere. P. 454.

Proceedings of the Royal Society. London. Vol. 74.

Lockyer, Norman and Lockyer, William, J. S. A probable cause of the yearly variation of magnetic storms and auroræ. Pp. 90–95.

Science Abstracts. London. Vol. 7.

B[orns], H. Heat exchange in the soil, the water and the atmosphere. [Abstract of article of J. Schubert.] P. 572.

Scottish Geographical Magazine. Edinburgh. Vol. 20.

— Meteorological results of the Belgian Antarctic Expedition. [Review of a pamphlet by H. Arctowski.] Pp. 493–494.

Symons's Meteorological Magazine. London. Vol. 39.

Gethin-Jones, J. R. The wettest place in Wales, with some remarks on the rainfall of the year 1903. Pp. 121–126.

— Wireless telegraph and meteorology. Pp. 127–128.

Annuaire de la Société Météorologique de France. Paris. 52^{me} année.

Teisserenc de Bort, L. Observations de la station franco-scandinave de sondages aériens à Haid. Pp. 159–161.

David [P]. Sur la distribution annuelle moyenne et extrême de la pluie dans les Îles Britanniques. [Analysis of a paper by Dr. Mill.] Pp. 161–165.

Angot, Alfred. La pluie à Bouin (Vendée). Pp. 173–177.

Archives des Sciences Physiques et Naturelles. Genève. 4^{me} période. Tome 17.

Forel, F. A. Variation de température avec l'altitude. P. 207.

Ciel et Terre. Bruxelles. 25^{me} année.

— Le climat du désert de Syrie. Pp. 303–304.